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First Named Inventor	Duncan
Art Unit	1754
Examiner Name	Lish
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Joanna L. Duncan,]
Christopher R. McLarnon, and Francis R. Alix] Examiner: Peter Lish
Serial No.: 09/683,267]
Confirmation No.: 3355]
Filed: 12/06/2001] Group Art Unit: 1754
For: NO_x, Hg, AND SO₂ REMOVAL USING]
AMMONIA]

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APPEAL BRIEF

37 CFR §1.192

1. Real Party in Interest. The real party in interest is the assignee of this application, Powerspan Corp., the inventors' employer.
2. Related Appeals and Interferences. None.
3. Status of Claims. Claims 1 – 4 and 6 – 16 are pending, and are appealed.
4. Status of Amendments. There have been no amendments filed subsequent to the Notice of Appeal.
5. Summary of Invention. The present invention is directed to a process for removing SO₂, NO, and NO₂ from a gas stream that does not require the addition of a catalyst, chlorine, or ozone, occurs at a relatively high pH, and does not result in ammonia slip. A process that satisfies these needs comprises the steps of oxidizing NO to NO₂ with an oxidizing means resulting in a mole ratio of SO₂ to NO₂ of at least 2.5 to 1 **60** [para. 0015 – 0026], followed by scrubbing SO₂, NO, and NO₂ from the flue gas stream with an ammonia scrubbing solution having a pH between six and eight **62** [para. 0027 – 0041], and removing any ammonia aerosols generated by the scrubbing steps with an aerosol removal means **64** [para. 0042].

6. Issue.

Whether claims 1 – 4 and 6 – 16 are unpatentable under 35 U.S.C. §103(a) over Aoki et al. (U.S. Patent No. 5,041,271), taken with Alix et al. (U.S. Patent No. 5,871,703) taken with Senjo et al. (U.S. Patent No. 4,035,470).

7. Grouping of Claims.

Claim 1, as amended, represents the pending claims.

8. Arguments.

a. *The Office erred in suggesting that the SO_x to NO_x ratio of 5:1 taught by Aoki is relevant to Applicants' SO₂ to NO₂ ratio of at least 2.5:1 of Claim 1.*

Applicants had amended claim 1, according to the Office's advice in their telephone interview of 7/22/2003, to add the SO₂ to NO₂ limitation found in former Claim 5 into Claim 1. [Telephone Interview Summary, 7/23/2003, page 2, lines 5 – 10.] After this amendment, the Office once again rejected Claim 1, saying, "It is additionally taught by Aoki et al. that the flue gas being treated contains, on average, a ratio of SO_x to NO_x of 5 to 1. Therefore, it is expected that after oxidation treatment, even at the highest rate of conversion, the gas will have a ratio of SO₂ to NO₂ of at least 2.5 to 1." [Office action mailed 12/12/2003, page 2, lines 8 – 10.]

Applicants disagree with the Office's conclusion. The 5:1 ratio in Aoki is merely the average SO_x to NO_x concentration resulting from burning coal, and reflects inlet conditions. In contrast, the 2.5:1 ratio in Claim 1 of the present application is a ratio required for the

Applicants' process to work, and reflects conditions after the oxidation step. [Application, para. 0016]

This interpretation is supported in the Aoki patent, col. 2, lines 17 – 23, Fig. 2, and Fig. 5, which says,

FIG. 2 is a typical chart showing variations in the SO_x and NO_x concentrations in coal combustion waste gas. The SO_x concentration has variations of about +/- 100 ppm with respect to an average value of 1500 ppm, while the NO_x concentration has variations of about +/- 20 ppm with respect to an average value of 300 ppm.

Dividing the SO_x concentration of 1500 ppm by the NO_x concentration of 300 ppm results in the 5:1 ratio.

Furthermore, the Office may be incorrectly assuming that all the SO_x is SO₂ and all the NO_x is NO₂. This is not the case.

Aoki in the '271 patent defines SO_x as "sulfur oxides" and NO_x as "nitrogen oxides." [col. 3, lines 60- 61] It is well known in the art that use of the subscript "x" can mean any species of the two elements, and implies nothing about their relative concentration. Furthermore, Aoki did not restrict this definition, or suggest relative concentrations, anywhere in the '271 patent. Aoki's use of the terms SO_x and NO_x are therefore consistent with the usual meaning that is known in the art.

The Applicants, in contrast, are quite specific about which species they are acting on in each of the pending claims. By simple algebra, it is entirely possible to come up with concentrations that satisfy the claim 1 requirement of "resulting in a mole ratio of SO₂ to NO₂ of at least 2.5 to 1" and yet fall outside Aoki's teaching of a SO_x to NO_x ratio of 5 to 1. The two

ratios are not mathematically dependent on each other. Therefore, the Office has made a conclusion with respect to Aoki that has no support in the record and is logically incorrect. The Office has not made a prima facie case of obvious with respect to the Aoki patent. Therefore, it should be removed as a reference against the present application.

b. *The Office erred in suggesting it would have been obvious to substitute the dielectric barrier discharge apparatus of Alix for the electron beam apparatus of Aoki because the Office gave insufficient weight to the Declaration Traversing Rejection.*

The Declaration Traversing Rejection under Rule 132, filed 8/26/2003, set forth facts, as opposed to legal conclusions, that tend to show the non-obviousness of the present invention. Such declarations may be used to explain the technical differences between the claimed invention and the prior art, and an examiner may refer to it in determining whether a claim is obvious or not. Ex parte Franklin, 41 USPQ 43 (Pat. Off. Bd. App. 1938). The Declaration points out the particular reasons why one would not substitute the e-beam of Aoki with the dielectric barrier discharge apparatus of Alix. To summarize, compared to using a dielectric barrier discharge (“DBD”) reactor, using e-beam is very an inefficient process, the apparatus is not economical, and there is no evidence that e-beam has any affect on Hg.

The first major difference is that e-beam produces much more highly energetic electrons than DBD, specifically 1,000 to 1,000,000 eV for e-beam compared to about 5 eV for DBD. [Declaration Traversing Rejection, para. 9] The result is that much of the SO_x is oxidized to SO₃ instead of SO₂, which is a needless waste of energy, among other things. The second difference is that e-beams must be created in a vacuum, whereas DBD does not. Third, e-beam causes a

radiation hazard that must be protected against using cement walls and the like. [Aoki, Fig. 7, and col. 2, line 59 to col. 3, line 17]

i. Applicants assert that there is no suggestion or motivation to combine the two references. Furthermore, the Declaration is evidence that the Aoki patent teaches away from the combination because it is economically undesirable, and may be inoperative because e-beam converts too much SO_2 to SO_3 to achieve the minimum 2.5 to 1 ratio required in the present invention, in which case the desired NO_2 removal would not be achievable.

The Office replied that, “the rejection requires the substitution of the barrier discharge oxidation method of Alix et al for the electron beam method of Aoki et al. Therefore, the argument was unpersuasive.” [Office action mailed 12/12/2003, page 2, lines 12 - 13.]

Applicants reply that the Office’s argument assumes its conclusion. The Applicant has supplied evidence that the e-beam of Aoki should not be substituted. Therefore, the e-beam apparatus of Aoki could not be substituted for the dielectric barrier discharge apparatus of Alix to perform the same oxidizing step in Claim 1 of the present application, and it is therefore non-obvious.

ii. Relevant to Claims 11 – 16, the Office also said it was not persuaded by the Declarant’s argument related to how e-beam should not be used for a system that oxidizes Hg. Particularly, the Office says, “Applicant argues that the use of the electron beam oxidation method on a gas containing mercury may result in the formation of radicals which may disturb the process. Applicant fails to show evidence that mercury in the flue gas will result in a negative effect on the oxidation process, and it is therefore expected that the mercury will be oxidized, as is shown in the art (see references to Alix et al.)” [Office action mailed 12/12/2003, page 2, lines 14 – 18]

Applicants reply that evidence was presented in the form of the above-mentioned Declaration, which was sworn to by an expert in the field. The assertions were supported by references cited in footnotes. The Office is requiring the Applicants to supply further evidence that may not exist. On the contrary, it is the responsibility of the Office to make the prima facie case, which it has not done on this point. Therefore, the e-beam apparatus of Aoki should not be substituted for the dielectric barrier discharge apparatus of Alix to perform the same oxidizing step in Claim 11 of the present application, and it is therefore non-obvious.

c. *The Office erred in suggesting that it would have been obvious to substitute the wet ESP taught by Alix for the dry ESP of Aoki because the Office gave insufficient weight to the Declaration Traversing Rejection, and because the Office relied on unsubstantiated general knowledge.*

As stated above, the Applicants assert that they gave sufficient evidence to rebut the Office's in the Declaration Traversing Rejection, para. 10. The wet ESP is well known to provide superior collection of ultra-fine particles and aerosols of 1 micron in size and smaller, when compared to a dry ESP. The reason why a dry ESP is less effective is that the resistance of the layer of particles on the collecting plate reduces the ability to transfer power into the ESP. In a wet ESP there is no particle layer on the collecting plate. Therefore, resistance is reduced, and more power can be applied, and the collection of fine particles and aerosols is improved. Using a wet ESP also prevents re-entrainment of particles, which is a significant shortcoming of dry ESPs. In fact, the superior performance of the wet ESP is vital to the present invention. A dry ESP would not work.

However, the Office maintained the rejection on the ground that, “the wet ESP is known to achieve the same effect as the dry ESP...” [Office action of 12/12/2003, page 3, line 2] This uncited and unsubstantiated statement by the Office is not true. If it were true, no one would go through the added expense to make a wet ESP when a dry ESP would do the same thing. Unfortunately, the Applicants’ cannot rebut general statements of knowledge unsupported by evidence. The Applicants’ therefore suggest that their Declaration provides sufficient evidence to overcome the Office’s assertion on this matter. Therefore, one cannot substitute the wet ESP in Alix for the dry ESP in Aoki, and therefore Claims 1 and 11 are not obvious.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Phillip E. Decker", with a long horizontal flourish extending to the right.

Phillip E. Decker

Reg. No. 39,163

Tel. No. 603-766-1910

Date: July 30, 2004

Attorney for Applicants

Decker Law Office

1 New Hampshire Ave., Suite 125

Portsmouth, NH 03801

9. Appendix: The Claims on Appeal.

1. A process for removing SO₂, NO, and NO₂ from a gas stream comprising the steps of
 - a. oxidizing at least a portion of NO in a gas stream to NO₂ with an oxidizing means resulting in a mole ratio of SO₂ to NO₂ of at least 2.5 to 1, followed by
 - b. scrubbing at least a portion of SO₂, NO, and NO₂ from the gas stream with a scrubbing solution
comprising ammonia, and
having a pH between 6 and 8, and
 - c. removing at least a portion of any ammonia aerosols generated from the scrubbing step from the gas stream with an aerosol removal means.
2. The process of claim 1, wherein said oxidizing means is an electrical discharge reactor.
3. The process of claim 2, wherein said electrical discharge reactor is a dielectric barrier discharge reactor.
4. The process of claim 3, further comprising the step of oxidizing at least a portion of the NO to HNO₃ with said dielectric barrier discharge reactor.
6. The process of claim 1, wherein said oxidizing step is adapted to result in a mole ratio of SO₂ to NO₂ of at least four to one.

7. The process of claim 1, said scrubbing solution
comprising ammonia, ammonium sulfite, ammonium sulfate, and water, and
having a pH between 6 and 8.
8. The process of claim 1, wherein said aerosol removal means is a wet electrostatic precipitator.
9. The process of claim 1, wherein said scrubbing step results in the formation of ammonium sulfate, the process further comprising the step of withdrawing ammonium sulfate from the scrubbing solution.
10. The process of claim 4, wherein said scrubbing step results in the formation of ammonium nitrate, the process further comprising the step of withdrawing ammonium nitrate from the scrubbing solution.
11. A process for removing SO₂, NO, NO₂, and Hg from a gas stream comprising the steps of
 - a. oxidizing at least a portion of the NO in a gas stream to NO₂, and at least a portion of the Hg in a gas stream to HgO, with an oxidizing means, followed by
 - b. scrubbing at least a portion of the SO₂, NO, and NO₂ from the gas stream with a scrubbing solution
comprising ammonia, and
having a pH between 6 and 8, and

- c. removing at least a portion of any ammonia aerosols generated from the scrubbing step, and HgO, from the gas stream with an aerosol removal means.
- 12. The process of claim 11, wherein said oxidizing means is an electrical discharge reactor.
 - 13. The process of claim 12, wherein said electrical discharge reactor is a dielectric barrier discharge reactor.
 - 14. The process of claim 11, wherein said aerosol removal means is a wet electrostatic precipitator.
 - 15. The process of claim 11, said scrubbing solution
comprising ammonia, ammonium sulfite, ammonium sulfate, and water, and
having a pH between 6 and 8.
 - 16. The process of claim 15, wherein said scrubbing step results in the formation of ammonium sulfate, the process further comprising the step of withdrawing ammonium sulfate from the scrubbing solution.